

REMARKS

Applicants respectfully request further examination and reconsideration in view of the above amendments and the comments set forth fully below. Claims 1-33 were pending. Within the Office Action, Claims 1-33 have been rejected. By the above amendment, Claims 1, 16-18 and 33 have been amended, Claims 3, 7, 8, 20, 24 and 25 have been canceled and new Claims 34-43 have been added. Accordingly, Claims 1, 2, 4-6, 9-19, 21-23 and 26-43 are now pending.

The independent Claims 1, 17, 18 and 33 have been amended by the above amendments in order to overcome the objections raised in the Office Action. The amended independent claims clearly define the present invention, describe the characteristics, objects and efficacy of the present invention and further distinguish features of the present invention from those of the cited references. All of the amendments are fully supported by the specification and figures of the present invention as originally filed.

Objections To The Specification

Within the Office Action, the disclosure is objected to for certain informalities. By the above amendment, the description regarding the concentration of HCl has been amended to read M (molar) in paragraphs 0014, 0049 and 0052, as suggested within the Office Action.

Objections To The Claims

Within the Office Action, Claims 3 and 20 have been objected to. By the above amendments, Claims 3 and 20 have both been canceled.

Rejections Under 35 U.S.C. § 102

Within the Office Action, Claim 17 has been rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,379,524 to Lee et al. (hereinafter referred to as "Lee"). The Applicants have amended Claim 17 by incorporating the technical features of pretreatments to porous substrates, whereby the strength between the palladium membrane and the porous stainless steel substrate will be highly enhanced. Lee fails to teach, suggest or imply any of the claimed pretreatments to the porous substrate. Therefore, the amended Claim 17 is allowable over the teachings of Lee.

Rejections Under 35 U.S.C. § 103

Within the Office Action, Claims 1, 2, 4, 5 and 15 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 3,350,846 to Makrides et al. (hereinafter referred to as “Makrides”) in view of Lee. Also, within the Office Action, Claims 3, 7 and 8 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee in view of U.S. Patent No. 4,055,686 to Steinberg et al. (hereinafter referred to as “Steinberg”).

After carefully reviewing the above references that have been cited and applied in the rejection of Claims 1-5, 7, 8 and 15, the Applicants have incorporated the technical features of Claim 3 into the independent Claim 1 and respectfully submit that none of the cited references, or any combination thereof, render the present invention obvious.

To clearly reflect the key points regarding the alleged issues, the condensed conclusion addressed in the Office Action is provided as below. Within the Office Action it is pointed out that Makrides teaches a hydrogen diffusion membrane formed by a metal core encompassed by sputtering two layers of palladium, which anticipates the claimed DC sputtering step. Then, it is indicated within the Office Action that Lee teaches that the method designed to prepare a palladium composite membrane by means of coating palladium metal membrane and palladium alloy membrane on a porous support includes electroless plating on a porous support, which corresponds to the claimed electroless plating step. Further, within the Office Action it is asserted that Steinberg teaches a method of forming metal hydride films on smooth surface including a polishing step, an acid-washing step, and a sputter etching step, which represent the technical features of the amended Claim 1 that are incorporated from Claim 3. It is then concluded within the Office Action, that in view of the cited references, the present technical features would have been obvious to one skilled in the art. The Applicants respectfully submit the distinguishable difference of the amended Claim 1 from the cited references as explained below.

(1) The difference between Lee and the present invention

Lee teaches that a palladium alloy or other complex compound is electroplated on a porous support to lessen the difference of standard electropotential between palladium and transition metal, so that a homogenous surface of the porous support is formed. However, the so called homogenous surface is formed only through one step of electroplating palladium complex compound on the commercial porous stainless steel substrate despite the commercial porous stainless steel substrate is made for filtration whose aperture is ranged from 0.2 - 0.5 μm . Contrary to the technical feature sought to be protected in the amended Claim 1, the substantive

homogenous surface is provided with the pretreatment to the porous substrate prior to the step of electroless plating palladium membrane onto the porous substrate. By means of the claimed pretreatment steps, the hydrogen diffusion membrane provided by the present invention would have higher hydrogen permeation.

(2) The difference between Makrides and the present invention

Makrides only teaches the preparation of palladium films deposited on the metal substrate by sputtering or evaporation on the vanadium, which does not pertain to the preparation of the whole hydrogen diffusion membrane itself. The present invention provides a thorough process to prepare a hydrogen diffusion membrane with high permselectivity, including the pretreatment to the porous substrate, metal filling of the porous substrate and the electroless plating treatment to the pretreated porous substrate. Therefore, the distinguishability of the present invention from the teachings of Makrides is apparent.

(3) The difference between Steinberg and the present invention

The Applicants would like to further add that plating a thin layer of palladium and other metal is simple and well known and has been employed to the various industries for surface protection and decoration at the time the present invention was made. Specifically, surface morphology in a smooth substrate and that in a porous substrate are entirely different, and thus the technical features of electroplating the palladium alloy membrane onto the different substrate surface patterns, or even the different surface materials, should not be considered in the same way.

Steinberg teaches how to manufacture a neutron generator target on a **smooth** copper substrate with titanium hydride in preference and further disclosed the cleaning steps after filling the substrate with the metal hydride, including a polishing, an acid-washing and a sputter etching. Contrary to the technical features, including mechanically polishing, electro-polishing, acid-washing and activating steps, as recited in the amended Claim 1, these steps are performed to smooth out the rugged and heterogeneous surface of the commercial stainless steel substrate before the porous substrate is filled with metal.

(4) The difference between the combination of Lee and Makrides in view of Steinberg and the present invention

The combination of Lee, Makrides and Steinberg only teaches a hydrogen diffusion membrane prepared by an integrated manufacturing process, including filling the porous

substrate with palladium complex compound, electroless plating the porous substrate, sputtering the porous substrate and cleaning the filled porous substrate. However, all of Lee, Makrides and Steinberg are silent in the claimed pretreatments to the porous substrate disclosed in the present invention.

The pretreatments to the porous stainless steel substrate provided in the present invention include mechanically polishing the porous support, electro-polishing the porous support, acid-washing the porous support and activating the porous support. The commercial porous stainless steel substrate is made for filtration rather than for surface deposition of membrane and is rated as 0.2 to 0.5 micron filtration grade. However, these stainless steel substrates are often full of 50 to 80 micron sized deep craters. These large craters make the subsequent surface deposition difficult and unreliable and thus it is hard to prepare a pinhole-free membrane on such substrate. With the mechanical polishing followed by electro-polishing to the porous stainless steel substrate, the degree of the sharp edge coverage of those craters existing in the porous substrate surface will be highly decreased. Moreover, despite there are still some larger craters after the pretreatments to the porous stainless steel substrate, these craters would be filled with palladium or niobium particulates with an adhesive where these particulates are hydrogen permeable. The present invention can provide a method for forming a supported palladium membrane disposed onto a substantively homogenous stainless steel substrate where the adhesion and strength between the palladium membrane and the porous stainless steel substrate will be highly enhanced and the long-term stability during high temperature and high pressure will be correspondingly raised. Therefore, the present invention can provide a hydrogen diffusion membrane with high hydrogen permselectivity and high H₂ flux.

In conclusion, the Applicants would like to further address that modifications to the general chemical process should be evaluated through the whole procedure to examine the improvement of the process in efficacy. In the present invention, the claimed pretreatments to the porous substrate indeed bring about the significant improvement for hydrogen diffusion membranes as well as reduce the cost of the manufacturing expenditure for preparing hydrogen diffusion membranes.

Accordingly, based on the foregoing reasons, it is respectfully submitted that the cited references do not disclose, suggest or render obvious the claimed invention. The amended independent Claim 1 is allowable over the teachings of the combination of Makrides, Lee and Steinberg, based on the above-mentioned reasons.

By the above amendments, Claims 3, 7 and 8 have been canceled. Claims 2, 4, 5 and 15 are dependent on the independent Claim 1. As discussed above, the independent Claim 1 is

allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claims 2, 4, 5 and 15 are all also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 6 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee and further in view of U.S. Patent No. 4,574,056 to Kimura (hereinafter referred to as “Kimura”). Claim 6 is dependent on the independent Claim 1. As discussed above, the independent Claim 1 is allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claim 6 is also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 9 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee and further in view of U.S. Patent No. 6,265,086 to Harkness (hereinafter referred to as “Harkness”). Claim 9 is dependent on the independent Claim 1. As discussed above, the independent Claim 1 is allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claim 9 is also allowable as being dependent on an allowable base claim.

Within the Office Action, Claims 10 and 11 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee and further in view of U.S. Patent Application Publication No. 2003/0141018 to Stevens et al. (hereinafter referred to as “Stevens”). Claims 10 and 11 are dependent on the independent Claim 1. As discussed above, the independent Claim 1 is allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claims 10 and 11 are both also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 12 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee and further in view of U.S. Patent No. 6,283,357 to Kulkarni (hereinafter referred to as “Kulkarni”). Claim 12 is dependent on the independent Claim 1. As discussed above, the independent Claim 1 is allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claim 12 is also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 13 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee and further in view of U.S. Patent Application Publication No. 2004/0094402 to Gopalraja et al. (hereinafter referred to as “Gopalraja”). Claim 13 is dependent on the independent Claim 1. As discussed above, the independent Claim 1 is allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claim 13 is also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 14 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee and further in view of U.S. Patent Application Publication

No. 2004/0238356 to Matsuzaki et al. (hereinafter referred to as “Matsuzaki”). Claim 14 is dependent on the independent Claim 1. As discussed above, the independent Claim 1 is allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claim 14 is also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 16 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee and further in view of U.S. Patent No. 4,313,013 to Harris (hereinafter referred to as “Harris”). Claim 16 is dependent on the independent Claim 1. As discussed above, the independent Claim 1 is allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claim 16 is also allowable as being dependent on an allowable base claim.

Within the Office Action, Claims 18, 19, 21, 22, 28, 29 and 32 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides and Lee and further in view of Stevens. Within the Office Action, Claims 20, 24 and 25 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides, Lee, Stevens and further in view of Steinberg. Within the Office Action, Claim 33 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Lee in view of Stevens.

After carefully reviewing the above cited references, the Applicants incorporate the technical features of Claim 20 into the independent Claims 18 and 33 and respectfully submit that none of the references cited within the Office Action, or any combination thereof, render the present invention obvious. The teachings of Lee, Makrides and Steinberg have been discussed above. Stevens teaches deposition of a conductive material over sub-micron apertures on a substrate using an electroless apparatus, wherein the used substrate is not a porous stainless steel substrate. It is asserted within the Office Action that the conductive material might correspond to the claimed Pd/Ag membrane and the electroless apparatus provides a heating function to anneal the Pd complex membrane, which also corresponds to the claimed anneal step.

The amended Claims 18 and 33 are distinguishable in electroless plating **Pd/Ag complex membrane** onto the porous substrate from Claim 1. The combination of the mentioned technical features are also silent in the pretreatment to the porous substrate as provided in Claim 1. Therefore, for the same reasons discussed above in reference to Claim 1, it is respectfully submitted that the cited references do not disclose, suggest or render obvious the claimed invention. For at least these reasons, the amended independent Claims 18 and 33 are allowable over the teachings of the combination of Makrides, Lee and Stevens and the combination of Lee and Stevens, respectively.

By the above amendments, Claims 20, 24 and 25 have been canceled. Claims 19, 21, 22, 28, 29 and 32 are dependent on the independent Claim 18. As discussed above, the independent Claim 18 is allowable over the combination of Makrides, Lee and Stevens. Accordingly, Claims 19, 21, 22, 28, 29 and 32 are all also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 23 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides, Lee and Stevens and further in view of Kimura. Claim 23 is dependent on the independent Claim 18. As discussed above, the independent Claim 18 is allowable over the combination of Makrides, Lee and Stevens. Accordingly, Claim 23 is also allowable as being dependent on an allowable base claim.

Within the Office Action, Claims 26 and 27 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides, Lee and Stevens and further in view of Harkness. Claims 26 and 27 are dependent on the independent Claim 18. As discussed above, the independent Claim 18 is allowable over the combination of Makrides, Lee and Stevens. Accordingly, Claims 26 and 27 are both also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 30 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides, Lee and Stevens and further in view of Gopalraja. Claim 30 is dependent on the independent Claim 18. As discussed above, the independent Claim 18 is allowable over the combination of Makrides, Lee and Stevens. Accordingly, Claim 30 is also allowable as being dependent on an allowable base claim.

Within the Office Action, Claim 31 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Makrides, Lee and Stevens and further in view of Harris. Claim 31 is dependent on the independent Claim 18. As discussed above, the independent Claim 18 is allowable over the combination of Makrides, Lee and Stevens. Accordingly, Claim 31 is also allowable as being dependent on an allowable base claim.

New Claims

By the above amendments, new Claims 34-43 have been added. Claims 34 and 35 are dependent on the independent Claim 1. As discussed above, the independent Claim 1 is allowable over the combination of Makrides, Lee and Steinberg. Accordingly, Claims 34 and 35 are both also allowable as being dependent on an allowable base claim.

Claims 36-38 are dependent on the independent Claim 17. As discussed above, the independent Claim 17 is allowable over Lee. Accordingly, Claims 36-38 are all also allowable as being dependent on an allowable base claim.

Claims 39 and 40 are dependent on the independent Claim 18. As discussed above, the independent Claim 18 is allowable over the combination of Makrides, Lee and Stevens. Accordingly, Claims 39 and 40 are both also allowable as being dependent on an allowable base claim.

Claims 41-43 are dependent on the independent Claim 33. As discussed above, the independent Claim 33 is allowable over the combination of Lee and Stevens. Accordingly, Claims 41-43 are all also allowable as being dependent on an allowable base claim.

For the reasons given above, the applicant respectfully submits that the claims are now in a condition for allowance, and allowance at an early date would be appreciated. Should the Examiner have any questions or comments, they are encouraged to call the undersigned at (408) 530-9700 to discuss the same so that any outstanding issues can be expeditiously resolved.

Respectfully submitted,
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